

# SnowEx: a NASA airborne campaign leading to a snow satellite mission

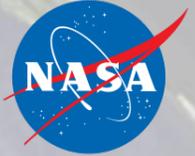
SnowEx update: July 21, 2016

**SnowEx Team/contributors to this report:** Edward Kim, Charles Gatebe, Amy Misakonis, Ludovic Brucker, Kelly Elder, Amanda Leon, Glen Liston & Jeff Deems

**Sponsored by NASA Headquarters/Terrestrial Hydrology Program Manager:** Jared Entin

# Outline

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- **Welcome:** Ed Kim/C. Gatebe (5 min)
- **Schedule & Logistics** – Amy Misakonis (10 min)
- **Airborne deployment plans** – Ed Kim (10 min)
- **Ground deployment plans:** K. Elder & L. Brucker (10 min)
- **Data protocols** – NSIDC/Amanda Leon (5 min)
- **Modeling needs** – Glen Liston (5 min)
- **Updates from NASA HQ**– Jared Entin (5 min)
- **Q&A** (10 min)

For more information, see [snow.nasa.gov](http://snow.nasa.gov)



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# **SCHEDULE STATUS AND RISKS**

Amy Misakonis

# SnowEx Major Milestones

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- Site Visit – Complete
- Winter Aircraft Selection – Complete
- Fall Deployment – 9/25/16 – 10/4/16
  - Ground Truth
  - ASO
- Instruments on Deck @ Aircraft Facility – 12/15/16
- Test Flight – 1/26/17 – 1/30/17
- Winter Deployment
  - Early GT Arrival – 2/1/17
  - Aircraft and GT Campaign – 2/6/17 – 2/24/17
- Final Data Delivery from all Instruments – 6/30/17

# Fall and Winter Efforts



- Fall - September 26-30, 2016 (proposed dates)
  - Fly LiDar to get no-snow background
  - Collect critical snow-free measurements
  - Collect some vegetation parameters
  - Collect some soil, land use, land cover, etc. data
- Winter – February 6-24, 2017 (proposed dates)
  - Fly *all* airborne sensors
  - Collect critical snow measurements
  - Vegetation or soil measurements?
- Summer (~ 1 week during Jun-Aug, 2017)
  - Fly radar to get no-snow background
  - Collect some soil and vegetation data
- Experiment Plan will address:
  - What must be measured in order to answer SnowEx questions?
  - What tools and resources are needed?



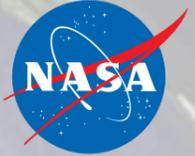
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# **SnowEx aircraft & instrument update**

E.Kim 7/21/16

# What's been happening?

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- Short story: we're in good shape!
- SnowEx organizing team has been working very hard to solidify aircraft plans
- Lots of details & coordination
- NRL colleagues have been very helpful
- Things have solidified a lot in the past 2 weeks

# Aircraft & Instruments for Each Deployment



- Fall 2016:
  - ASO on its aircraft
    - Lidar (1064 nm; 3.5 km/1m @ 3 km alt.)
    - Hyperspectral (350-1050 nm;  $\pm 34^\circ$ )
- Winter 2017:
  - NRL P-3
    - SAR (SnowSAR; X and Ku band polarimetric imaging radar, ~5m spatial resolution)
    - Passive microwave (AESMIR; 10, 19 and 37GHz; H and V; 200 m @ 600 m alt.)
    - BRDF (CAR) (multispectral: 340-2300 nm; iFOV:  $1^\circ$ /FOV:  $180^\circ$ )
    - Thermal IR (TBD)
  - ASO on its aircraft
    - Lidar
    - Hyperspectral
- Summer 2017 (SAR (SnowSAR); aircraft TBD)

# Next steps

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- Fleshing out detailed experiment plans for each instrument.
  - Closely coordinated w/ground truth and GBRS
- Identifying airport to be used by P-3 & associated logistics/communications w/ground efforts.

# Example: P-3 flight planning

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- All P-3 instruments will be observing during the entire flight
- P-3 more stable -> better SnowSAR calibration
- Each instrument (except thermal IR) has an optimum altitude or flight profile, so
  - The P-3 will fly the GM target area ~3 times during a flight, with different altitudes/profiles
- SB flight requirements are different; profile will be different than GM
- Future webexs will discuss flight planning in detail
- One P-3 flight per flight day
- Currently expecting ~5 flight days over 3 weeks
- Exploring ways to have 6 flights

# Ground Deployment Plans

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Local Scale Observation Sites  
(LSOS)

Intensive Observation Period  
(IOP)

- Kelly Elder & Ludovic Brucker

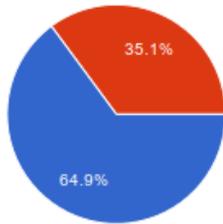


# Participation Survey

<http://goo.gl/forms/gHQniD9MeDQeojqg1>

As of 7/20: - 37 entries  
- 88 people (including 37 students)

A small field work campaign is expected to occur in September/October 2016. Would you be interested?



Yes	24	64.9%
No	13	35.1%

I was not expecting such a high number

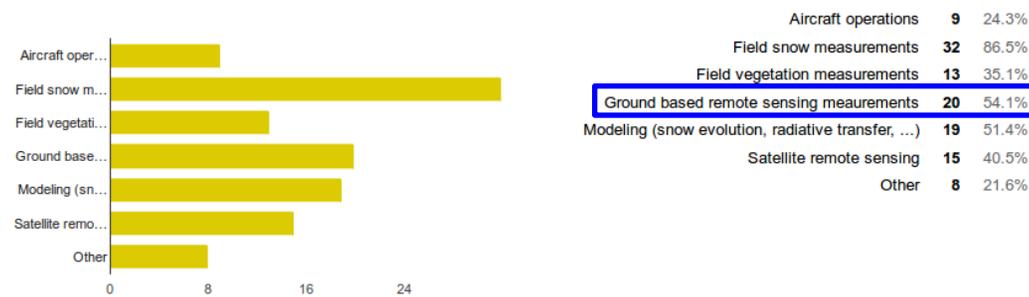


# Participation Survey

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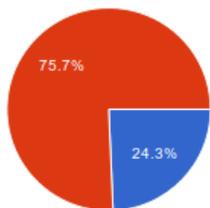
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Will your participation be in the area of



[Complete the GBRs survey](#)

Do you have tower-mounted sensors or field-deployed equipment that need to be installed in September/October?



Yes 9 24.3%  
No 28 75.7%

[Complete the GBRs survey](#)

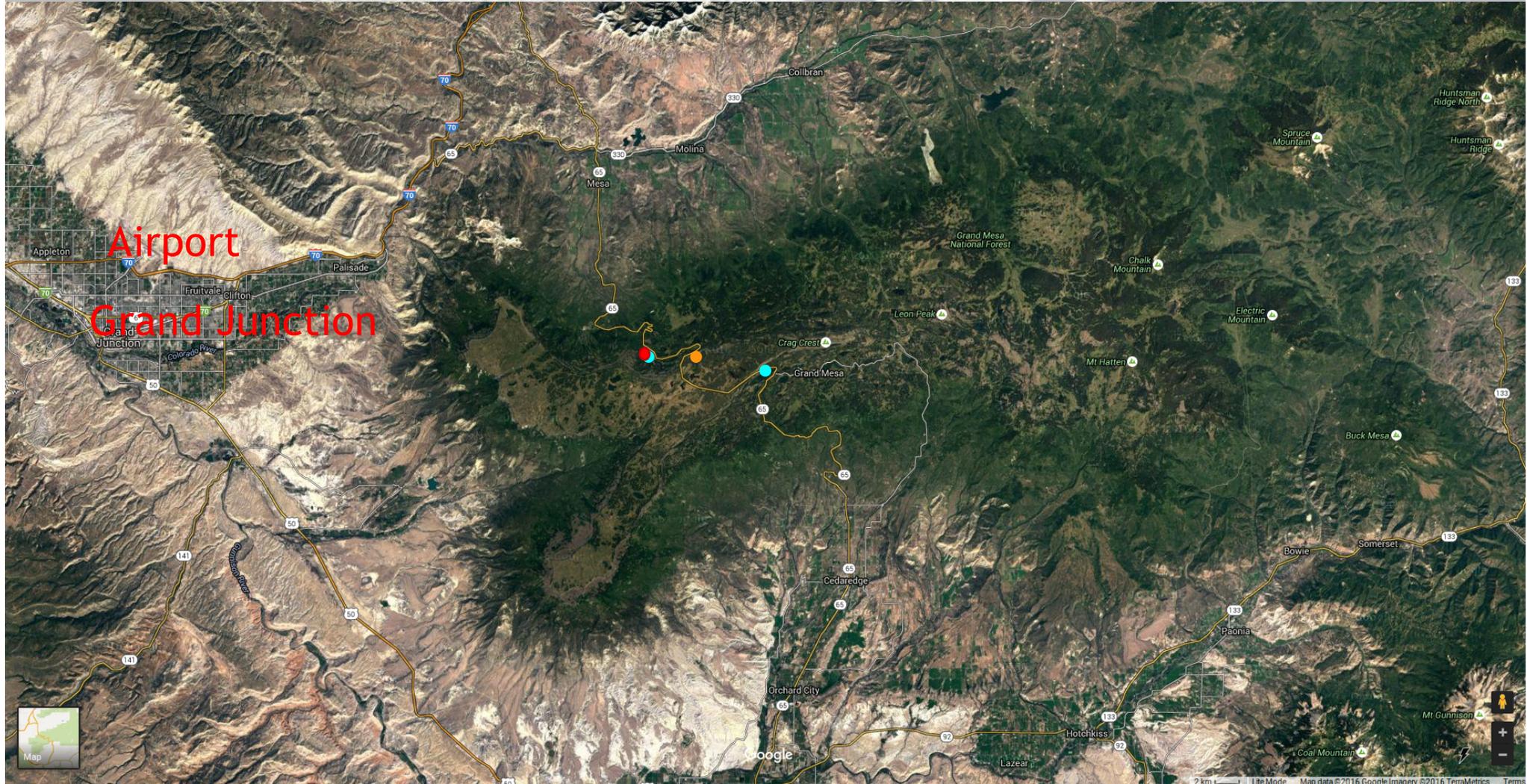
Complete the GBRs survey at <http://goo.gl/forms/7zg2z5e2ONpm5fF32>



LSOS

Lodges

Grand Mesa Study Plot





LSOS

Lodges

Grand Mesa Study Plot

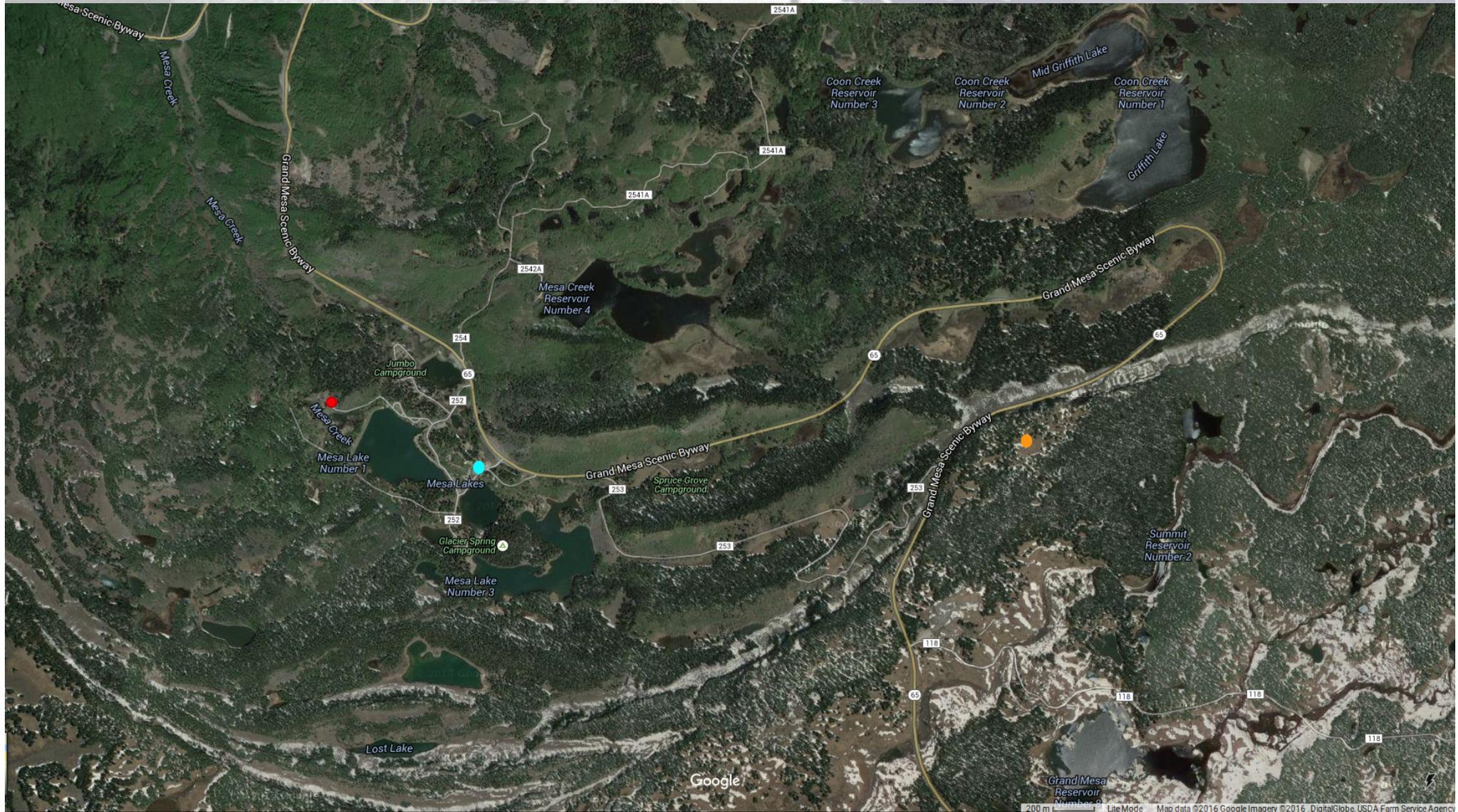




LSOS

Lodges

Grand Mesa Study Plot



# Local Scale Observation Sites (LSOS)



artist interpretation!

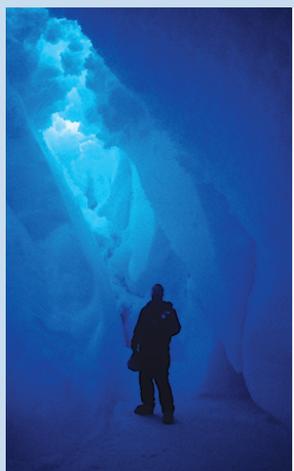


Weather Station  
Sun photometer

Microwave sensors (radar, radiometer)  
Snowpit areas



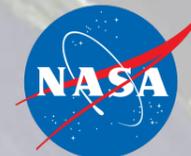
National Snow and Ice Data Center  
Advancing knowledge of Earth's frozen regions



# NSIDC DAAC Data Management for SnowEx

*Amanda Leon*  
*21 July 2016*

# NSIDC DAAC data management experience



## METHOD



## COVERAGE



# NSIDC DAAC data management experience



Cold Land Processes  
Field Experiment (CLPX)

AMSR-E and SMAP  
Validation Field  
Campaigns



Operation IceBridge

Airborne Snow  
Observatory



AMSR-E  
ICESat  
ICESat-2  
MODIS  
SMAP  
SSM/I-SSMIS



# What the DAAC can provide



- Consultation on data structure and organization
- Assistance with metadata content and creation
- Data QA and metadata generation in the field

- Automated data transfer methods
  - Online archive with built in data integrity monitoring and backups

Create

Store

Share

Use

- Web portal for data access and related resources
- Leverage existing data access capabilities (e.g. OPeNDAP)
- Inclusion in NASA Earth Science discovery tools

- Develop product user guides and resources (How Tos)
- Creation of services to reduce barriers to usage (e.g., reformatting)
- Personalized user support

# What the DAAC needs from SnowEx



## Data Creation

- Understanding of instruments, data products and data volumes
- Discussion on data formats
- Creation of metadata files (There's an app for that)

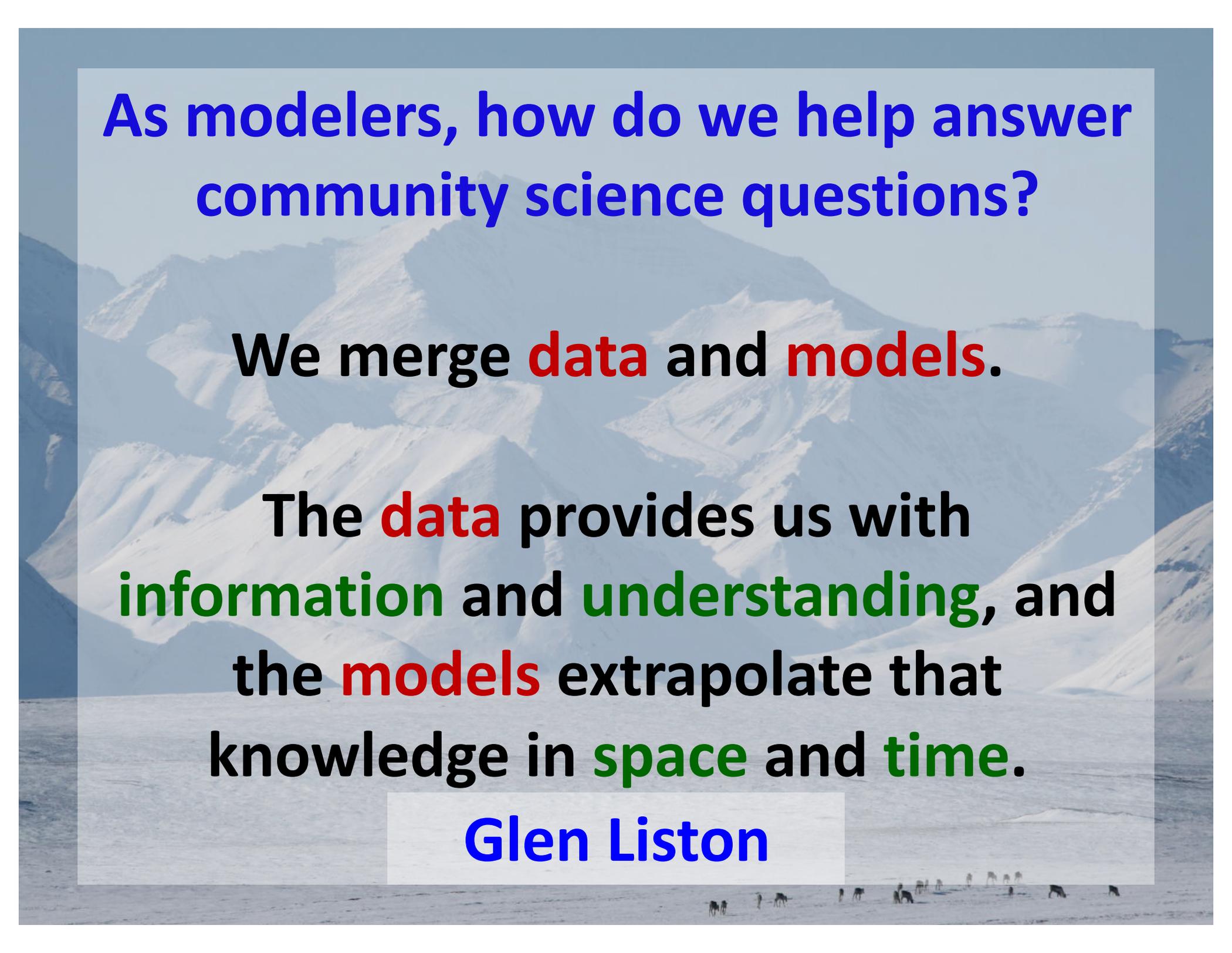
## Data Storage

- Establish data transfer protocols with each instrument team

## Data Sharing and Usage

- Assistance creating user product guides and developing discovery metadata
- Insight into user community needs





As modelers, how do we help answer  
community science questions?

We merge **data** and **models**.

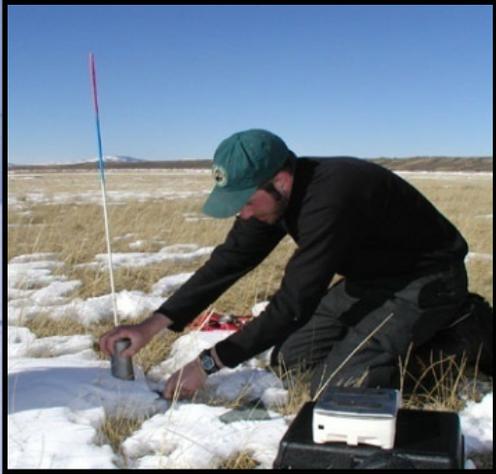
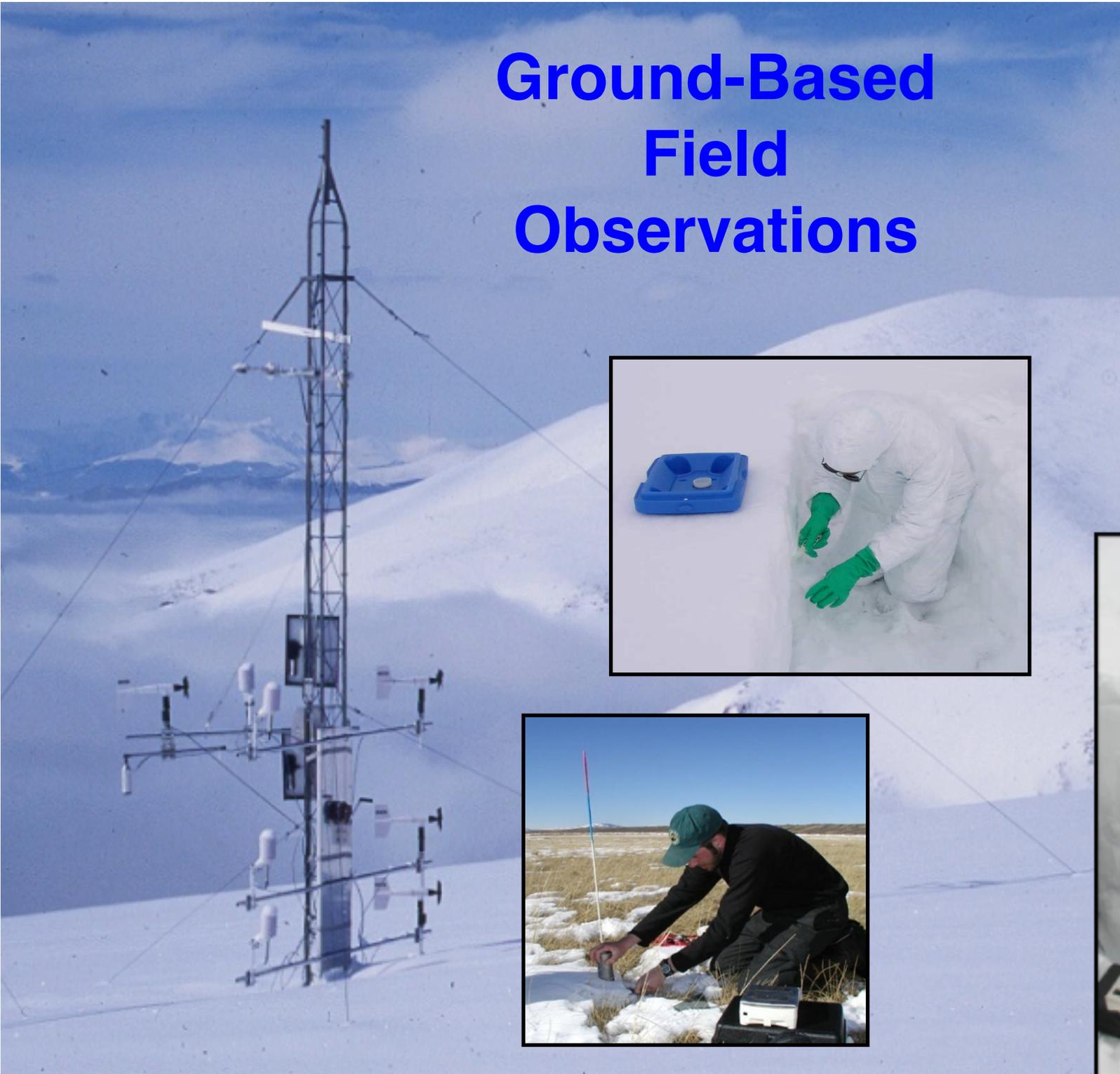
The **data** provides us with  
**information** and **understanding**, and  
the **models** extrapolate that  
knowledge in **space** and **time**.

**Glen Liston**



**So it all begins with our field observations and datasets**

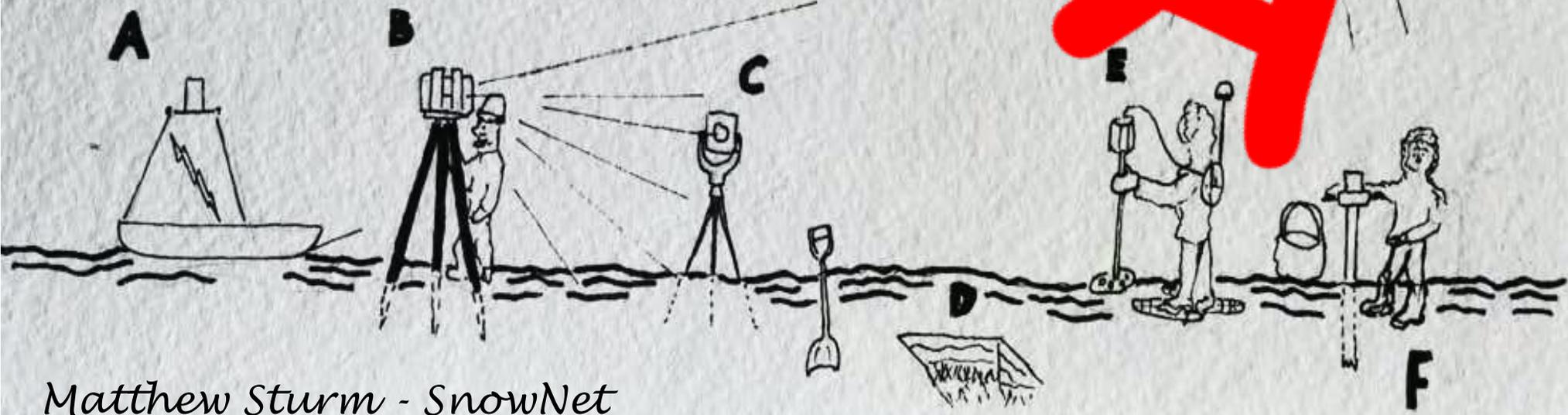
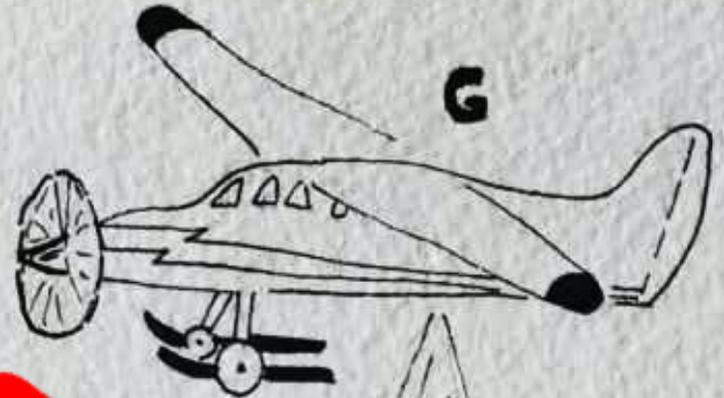
# Ground-Based Field Observations





A  
B  
C  
D  
E  
F  
G  
H  
I

Ground-based LiDAR sled  
LiDAR  
Coring  
Snow  
GPS-enabled snow probe  
Coring for snow water equivalent  
Aircraft flying w/ LiDAR  
Airborne LiDAR  
GPS satellite



Matthew Sturm - SnowNet

# Model Simulation Data Requirements



**Basic meteorological data time series (for the entire snow season, including radiation components).**



**Focus on winter (solid) precipitation (snowfall); precipitation gauges, snow pillows, sonic sounders.**



**Gridded topography and land-cover datasets at the resolution of interest to this study (1-m horizontal grid?).**



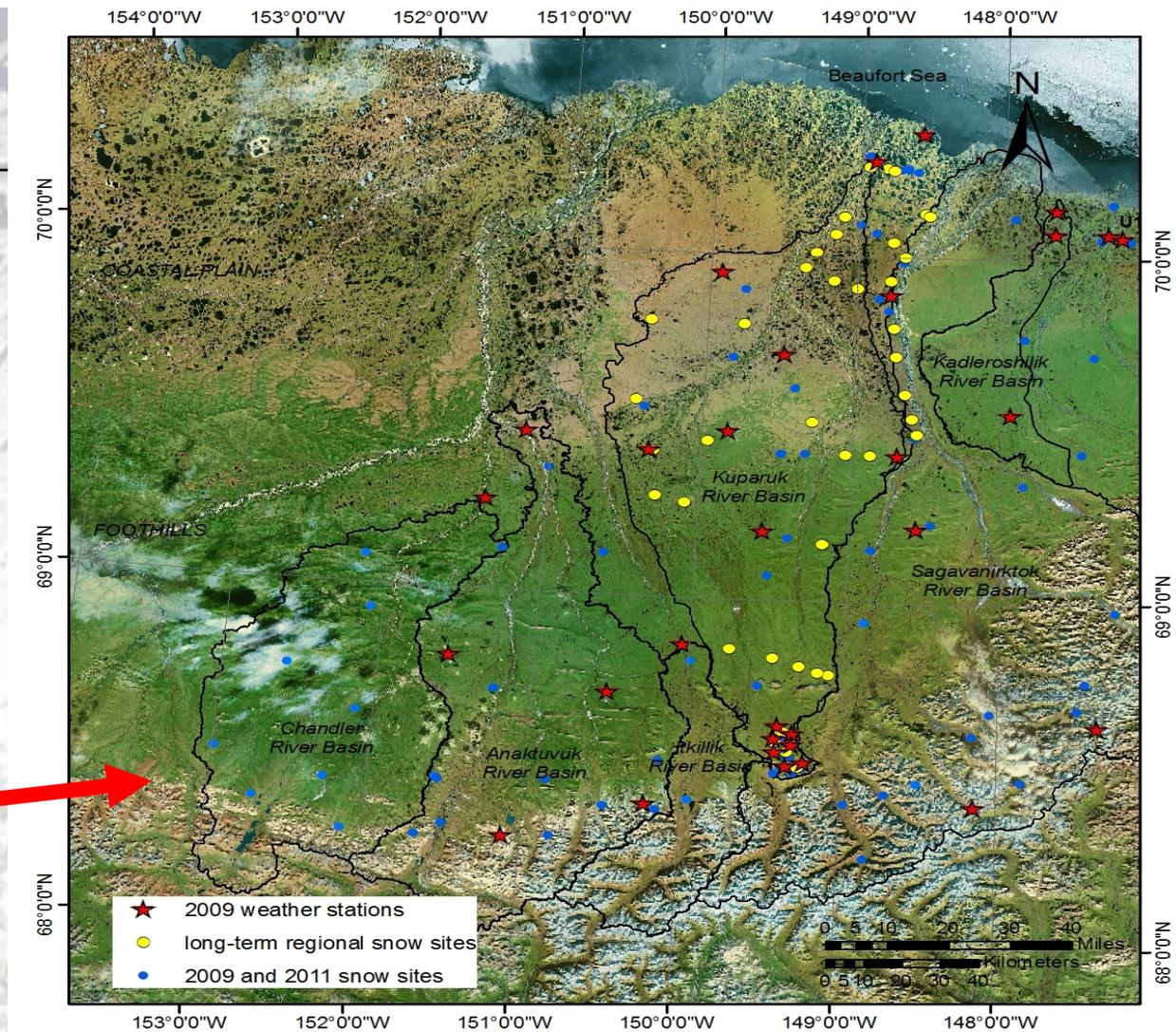
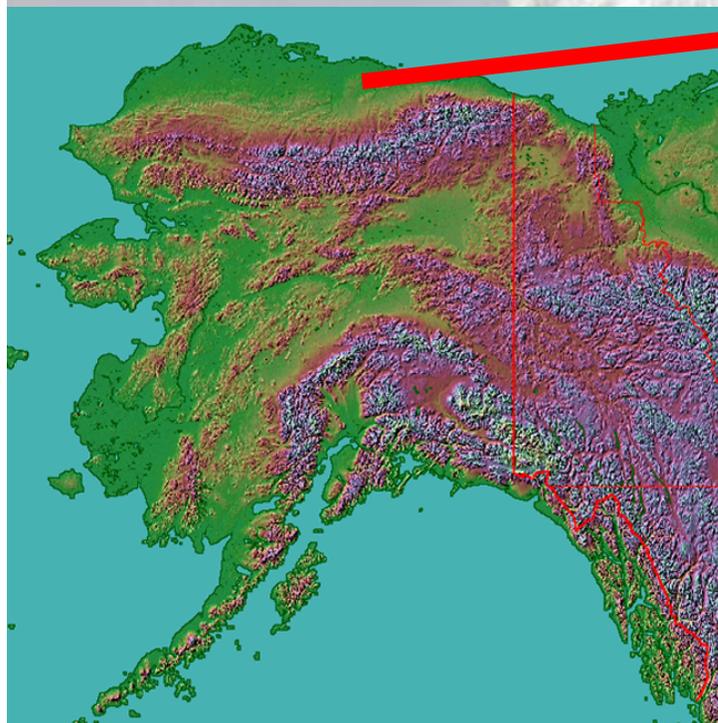
**Gridded vegetation parameter datasets (e.g., canopy density, structure, LAI, etc.).**



**Snow-related measurements; SWE, density, depth, albedo, wetness, grain size, etc.**

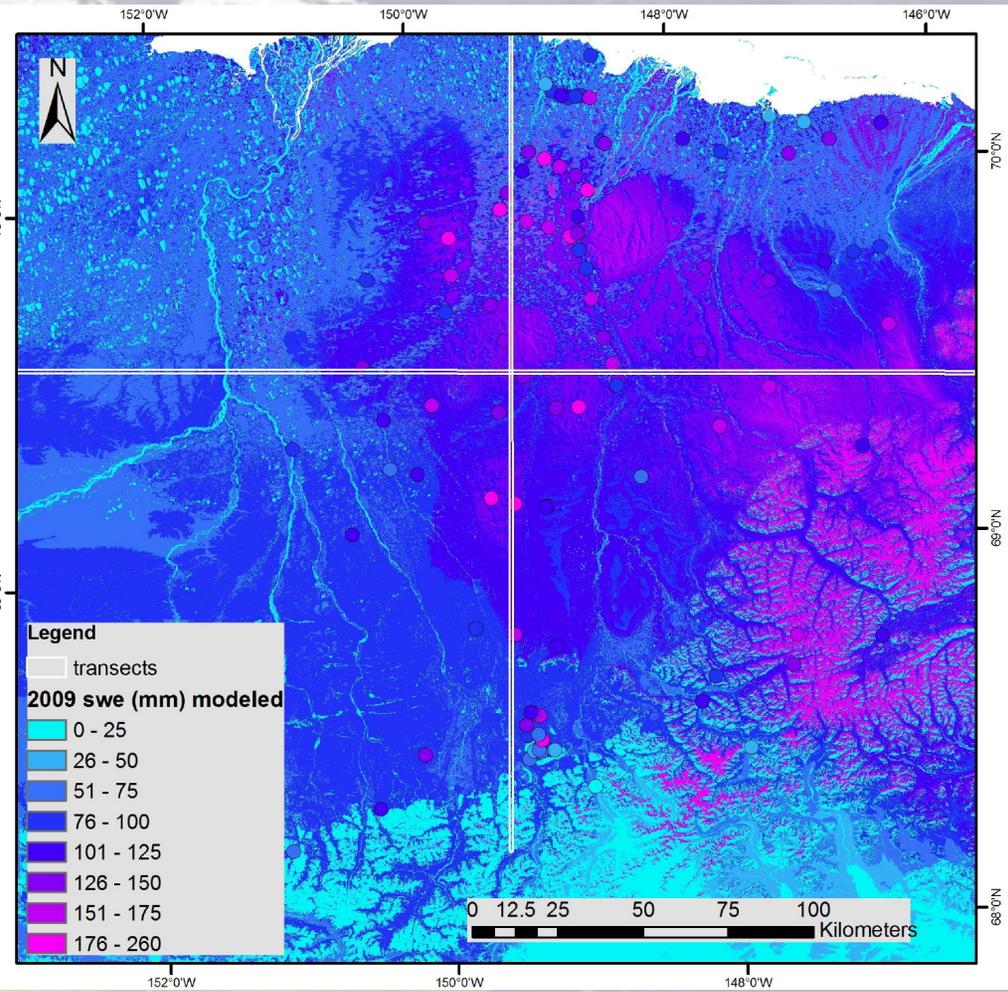
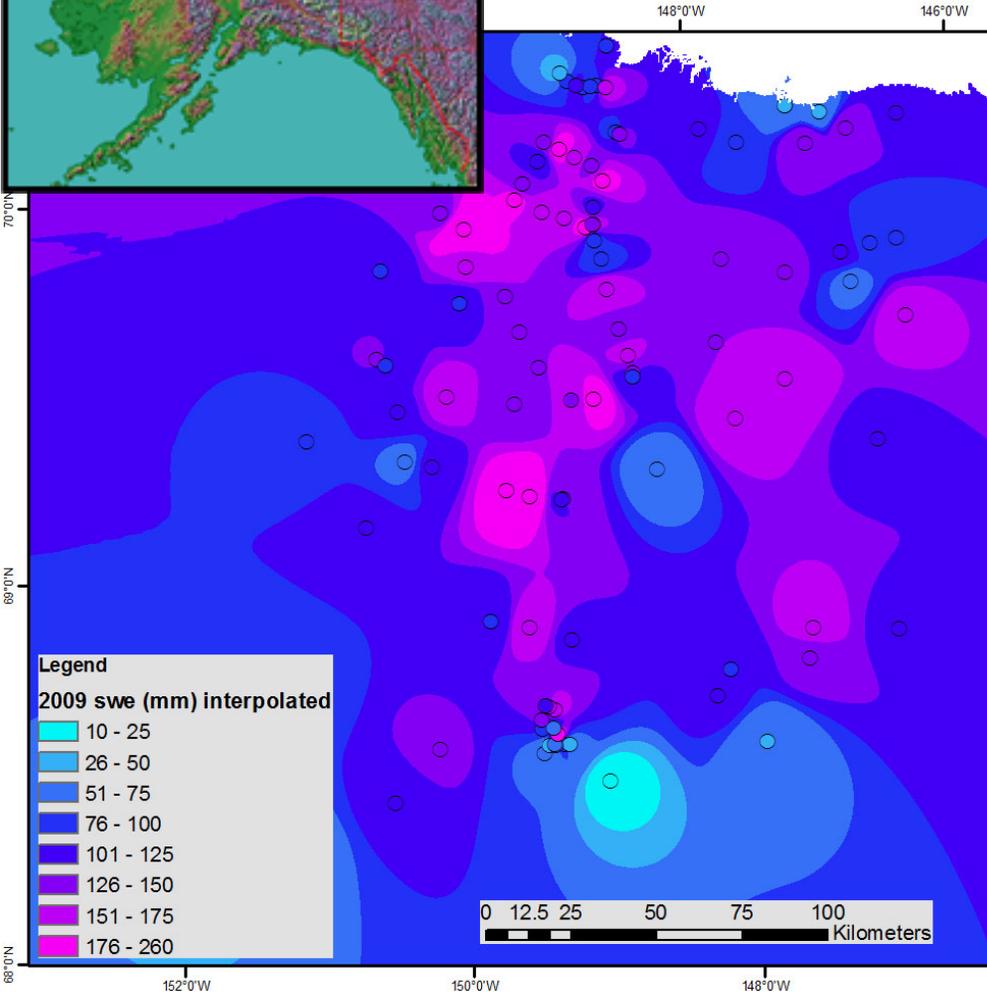
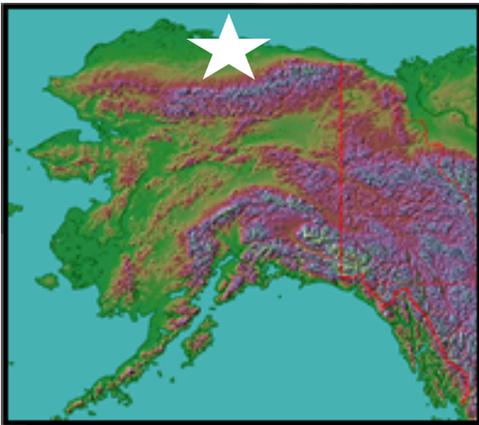
# Arctic Alaska Example

Stuefer et al. (2013)



**Location of Arctic Alaska  
snow survey sites (dots) and  
weather stations (stars).**

# Arctic Alaska



(Left) Interpolated snow observations. (Right) SnowModel simulated (100-m grid) and observed (dots) snow water equivalent (SWE) on 21 April 2009.

# The End

Kenneth G. Libbrecht

